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CERTIFICATION OF TRANSLATION

Title of Translated Document: Japanese Unexamined Patent Application (Kokai) No. 2001-55861
A Balancing Apparatus for Double-Hung Windows

Original Language of Translated Document: **Japanese**

The undersigned declares that:

1. I am a professional translator with English as a native language and Japanese as an acquired language. With over forty years of full-time translating experience in technical, chemical and related fields.
2. To the best of my knowledge and belief, the attached is a true, accurate and complete English translation of the above-referenced Japanese document.

Date: 24 June 2003 Signature: Charles P. Ridley

Charles P. Ridley

Attachment to amendment #7
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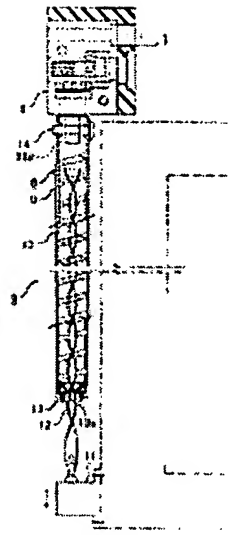
Clear drawings and a statement of competence by the translator are attached to the back of this translation. The translation includes amendments made in the Japanese application. For convenience of the reader, the translator included the translation of the as-filed application, plus the translated application with the translated amendments in place.

(54) [Title of the Invention] A Balancing Apparatus for Double-Hung Windows

(57) [Abstract]

[Problem] To make it possible to adjust balancing force in steps and easily without compelling painful working postures.

[Means of Solution] The balancing apparatus 5 is constructed of the balancing force adjustment apparatus 6, which is affixed and arranged in a position above the vertical frame pieces 2A and 2B, the balancing force generation apparatus 8, which is installed connected to the aforementioned balancing force adjustment apparatus 6, in which the torsional spring 10 and the torsional spring housing tube 9 are set so that they are rotated freely by the adjustment operation in the balancing force adjustment apparatus 6 and with which introduction and adjustment of the balancing force on the torsional spring 10 is possible, the slide block 11, which is raised and lowered accompanying the vertical movement of a movable pane 3 and the spiral lever 12, which is affixed at the bottom end to the slide block 11, the top end part of which passes through the rotating working element 13 of the balancing force generation apparatus 8 and is inserted into the interior of the torsional spring housing tube 9, which exerts a winding tight action and a winding back or unwinding action on the torsional spring 10 by applying rotational force around the perpendicular axis on the aforementioned rotating working element 13 accompanying vertical movement of the movable pane 3.



[Claims]

[Claim 1] A balancing apparatus for double-hung windows characterized in that it is a balancing apparatus that is installed in movable panes that open and close in the vertical direction, that maintains the weight and mechanical equilibrium relationship of said movable pane and can stop the movable pane in any desired position and that simplifies the opening and closing operations,

in that the aforementioned balancing apparatus is constructed of a balancing force generation apparatus that is comprised of a balancing force adjustment apparatus that is affixed and arranged in a position above the vertical frame pieces, a balancing force generation apparatus that is comprised of a torsional spring housing tube, a torsional spring that is housed inside it and a rotating working element that is installed in the bottom end part of the torsional spring, which is connected to the aforementioned balancing force adjustment apparatus and is installed in a vertical arrangement, which rotates around at least the torsional spring shaft core due to adjustment operations in the balancing force adjustment apparatus, with which the introduction and adjustment of balancing force on the torsional spring is possible and which provides a balancing force in the upward direction on the movable pane due to the aforementioned torsional spring when the movable pane is opened and closed, a slide unit that is affixed in the lower end of the aforementioned movable pane and that rises and falls accompanying the vertical movement of the movable pane and a spiral lever which is affixed at the bottom end of the slide block, the top end part of which

passes through the rotating working element of the balancing force generation apparatus and is inserted into the interior of the torsional spring housing tube, which exerts a winding tight action and a winding back or unwinding action on the torsional spring by applying rotational force around the perpendicular axis on the aforementioned rotating working element accompanying vertical movement of the movable pane.

[Claim 2] A balancing apparatus for double-hung windows as described in claim 1 in which the aforementioned balancing force adjustment apparatus is comprised of a case, a horizontal gear component that is arranged in a specified position in the case so that it rotates freely around a horizontal axis, which is constructed of a head part and a shaft part, which is provided with a gear in the periphery the step difference part between the aforementioned head part and shaft part, in which a circular throughhole is formed by the end face of the aforementioned head part and in which a polygonal throughhole that is connected to the circular throughhole and that extends into the shaft part is formed, a spring component which is inserted into the aforementioned polygonal throughhole of the horizontal gear component, a balancing force adjustment component 25 that is comprised of a polygonal head part, a guard part that is adjacent to the polygonal head part and that is of large diameter and a shaft part, which is polygonal in cross section, and which fits into the polygonal throughhole of the aforementioned horizontal gear part, which is inserted and arranged in the throughhole of the aforementioned horizontal gear component, which is energized and held outwards by the aforementioned spring component, which

cannot rotate due to engagement with a lock stophole that is formed in the case when in a protruded state, which stops the rotation of the aforementioned horizontal gear component, which permits rotation around the shaft core together with the aforementioned horizontal gear component only at times of a state in which it is pushed in opposition to the aforementioned energizing force and which applies rotation to the aforementioned horizontal gear component, and of a vertical gear component which is arranged in specified position in the aforementioned case so that it rotates freely around the vertical axis, which is equipped with a gear in the top part that engages with the aforementioned horizontal gear component, which is equipped with a linking shaft on the lower end and which is arranged so that it engages with the aforementioned horizontal gear component and which is rotated passively by the rotation of the aforementioned horizontal gear component, and in that the linking shaft of the aforementioned vertical gear component, is connected at least to the torsional spring of the aforementioned balancing force generation apparatus.

[Claim 3] A balancing apparatus for double-hung windows as described in either claim 1 or 2 in which the stop that forms the top position of the movable pane is set on the outer side of the case of the aforementioned balancing force adjustment apparatus.

[Detailed Description of the Invention]

[0001]

[Technological field of the invention] This invention relates to a balancing apparatus for double-hung windows that is equipped onto a movable pane that opens and closes in the vertical direction.

[0002]

[Prior art] In double-hung windows in which a pane is opened in the vertical direction, a balancing apparatus is used that maintains the pane weight and mechanical equilibrium relationship in regard to the aforementioned pane so that the pane can be moved upwards or downwards simply by a slight force and for the purpose of stopping it in any desired position. This balancing apparatus is an apparatus that uses the torsional force of a torsional spring to act on a spiral lever. Known instances are described in Japanese Patent Application Early Disclosure No. 3 [1991] -161,683, Japanese Patent Application Early Disclosure No. 3 [1991] -180,683 and Japanese Patent Application Early Disclosure No. 4 [1992] -238,984. These inventions relate primarily to adjustment of the torsional force of the aforementioned torsional springs. Specifically, adjustment mechanisms that have been proposed conventionally can be generally divided into devices in which an adjustment shaft that is installed in a slide apparatus is rotated in one direction only by a ratchet mechanism and devices in which a coiled brake spring is wound around the adjustment axis and a braking force is applied to the adjustment shaft by tight binding force.

[0003]

[Problems the invention is intended to solve] Although adjustment structures based on the aforementioned ratchet structure provide extremely good

conditions for tight closing of torsional springs, there is the drawback that they cannot be wound back, for which reason adjustment is limited to one direction. On the other hand, devices using brake springs are superior to the aforementioned ratchet mechanism in that both tight closing and unwinding are possible. However, there are the problems that the braking force by the brake spring is not secure, that unwinding occurs spontaneously due to slipping and that a sufficient braking function cannot be maintained over long periods because loosening occurs over the course of time. Moreover, there is the further problem that the adjustment shaft must be rotated against the resistance of the brake spring so that a great effort must be expended in adjustment.

[0004] By comparison to these ratchet structures and brake structures, the balancing apparatus described in Japanese Patent Application Early Disclosure No. 4 [1992] -238,984 is superior to the other devices in that a reliable braking force is obtained using the wedge effect of the direction of rotation of the adjustment shaft and that unwinding can be performed simply. However, there are the problems that there is a large number of parts, making the structure of the braking part complex, and that adjustment cannot be made in steps during unwinding.

[0005] Further, in the method of adjusting the balancing force that provides rotation to the torsional spring in these balancing apparatuses, a spiral lever is connected to the adjustment shaft, which is installed in a slide apparatus so that it rotates freely around the vertical shaft, a device such as a screwdriver is introduced into a + shape groove that is formed in the bottom face of the

adjustment shaft and that the screwdriver rotates around the vertical shaft, for which reason there is the problem that that the adjustment operation is difficult because a painful operating posture is intensified.

[0006] The principal object of this invention is to provide a balancing apparatus for double-hung windows whereby the painful operating posture is not intensified, adjustment of the balancing force can be performed easily, winding tight and unwinding can be performed simply after adjustment without occurrence of relaxation and slipping, and winding tight can be performed in steps in relation to unwinding.

[0007]

[Means for solving the problems] This invention, which is for the purpose of solving the aforementioned problems, is characterized in that it is a balancing apparatus that is installed in movable panes that open and close in the vertical direction, that maintains the weight and mechanical equilibrium relationship of said movable pane and can stop the movable pane in any desired position and that simplifies the opening and closing operations, in that the aforementioned balancing apparatus is constructed of a balancing force generation apparatus that is comprised of a balancing force adjustment apparatus that is affixed and arranged in a position above vertical frame pieces, a torsional spring housing tube, a torsional spring that is housed inside it and a rotating working element that is installed in the bottom end part of the torsional spring, which is connected to the aforementioned balancing force adjustment apparatus and is installed in a vertical arrangement, which rotates around at least the torsional spring shaft core

due to adjustment operations in the balancing force adjustment apparatus, with which the introduction and adjustment of balancing force on the torsional spring is possible, and which provides a balancing force in the upward direction on the movable pane due to the aforementioned torsional spring when the movable pane is opened and closed, a slide unit that is set in the lower end of the aforementioned moveable pane and that rises and falls accompanying the vertical movement of the movable pane and a spiral lever which is affixed to the bottom end of the slide block, the top end part of which passes through the rotating working element of the balancing force generation apparatus and is inserted into the interior of the torsional spring housing tube, which exerts a winding tight action and a winding back or unwinding action on the torsional spring by applying rotational force around the perpendicular axis on the aforementioned rotating working element accompanying vertical movement of the movable pane.

[0008] Specifically, the structure of the aforementioned balancing force adjustment apparatus can be a structure in which a case, a horizontal gear component that is arranged in a specified position in the case so that it rotates freely around a horizontal axis, which is constructed of a head part and a shaft part, which is provided with a gear in the periphery of the step difference part between the aforementioned head part and shaft part, in which a circular throughhole is formed by the end face of the aforementioned head part and in which a polygonal throughhole that is connected to the circular throughhole and that extends into the shaft part is formed, a spring component that is inserted into

the aforementioned polygonal throughhole of the horizontal gear component, a balancing force adjusting component that is comprised of a polygonal head part, a guard part that is adjacent to the polygonal head part and that is of large diameter and a shaft part, which is polygonal in cross section and which fits into the polygonal throughhole of the aforementioned horizontal gear part, in that it is inserted and arranged in the throughhole of the aforementioned horizontal gear component, which is comprised of a balancing force adjusting component, which is energized and held outwards by the aforementioned spring component, which cannot rotate due to engagement with a lock stophole that is formed in the case when in a protruded state, which stops the rotation of the aforementioned horizontal gear component, which permits rotation around the shaft core together with the aforementioned horizontal gear component only at times of a state in which it is pushed in opposition to the aforementioned energizing force and which applies rotation to the aforementioned horizontal gear component, and of a vertical gear component that is arranged in specified position in the aforementioned case so that it rotates freely around the vertical axis, which is equipped with a gear in the top part that engages with the aforementioned horizontal gear component, which is equipped with a linking shaft on the lower end and which is arranged so that it engages with the aforementioned horizontal gear component, and which is rotated passively by the rotation of the aforementioned horizontal gear component and in which the linking shaft of the aforementioned vertical gear component is connected at least to the torsional spring of the aforementioned balancing force generation apparatus. Further, the

stop that forms the top position of the movable pane may be set on the outer side of the case of the aforementioned balancing force adjustment apparatus.

[0009] In this invention, the balancing force adjustment apparatus is installed on the top side of the balancing force generation apparatus so that torsional force can be applied directly at the top to rotate the torsional spring of the aforementioned balancing generation apparatus. Consequently, the aforementioned working adjustment component that stands beside and is exposed to the double-hung window can operate simply for introduction and adjustment of the initial torsional force simply by rotation by means of a device such as a screwdriver. In addition, torsional force is applied by rotation of a gear component and rotation of the gear component can be released from a stopped state simply by pushing in. For this reason, tight closing and unwinding adjustments can be performed simply and there is no occurrence of slackness or slipping after adjustment. Moreover, there are the advantages that tight winding can be adjusted in steps relative to unwinding and that the operator can introduce and adjust the torsional force from the horizontal direction while standing.

[0010] [Embodiment of the invention] We shall now present a detailed description of the embodiment of this invention by reference to the figures. Figure 1 is a frontal view of the double-hung window 1 equipped with the balancing apparatus 5 and Figure 2 is a structural diagram of the balancing apparatus 5.

[0011] The double-hung window 1 is equipped with the inner pane 3 and the outer pane 4 that are raised and lowered freely inside the window frame 2 along the vertical frame pieces 2A and 2B. The aforementioned panes 3 and 4 can be held in any desired position by the balancing apparatuses 5 and 5 that are installed along the aforementioned vertical frame pieces 2A and 2B. The aforementioned balancing apparatuses 5 are installed with the inner pane 3 and the outer pane 4. The two differ only in the lengthwise dimensions of the torsional spring housing tube 9, the torsional spring 10 and the spiral lever 12, to be described subsequently, and in that the stop 7, which is freely attached and detached, is installed on the outer side of the balancing apparatus 5 only for the inner pane 3. Because their basic structures are the same, only the inner pane 3 (hereafter referred to simply as pane) is described.

[0012] The aforementioned balancing apparatus 5, as shown in detail in Figure 2, is affixed and arranged above the vertical frame pieces 2A and 2B and is comprised of the balancing force adjustment apparatus 6 for adjustment of the balancing force, the balancing force generation apparatus 8 which is installed connected to the balancing force adjustment apparatus 6, which is equipped with the torsional spring 10 inside the torsional spring housing tube 9 and which provides a balancing force in the upward direction essentially on the pane 3, the slide block 11, which is affixed in the lower frame side of the pane 3 and which is raised and lowered with the pane 3, and, for the purpose of actively linking the slide block 11 and the aforementioned balancing force generation apparatus 8, the spiral lever 12 which connects the lower end with the aforementioned slide

block 11, the top end of which is inserted into the interior from the bottom end face of the aforementioned balancing force generation apparatus 8 and which winds tight/unwinds the torsional spring 10 that is installed inside the aforementioned balancing force generation apparatus 8 accompanying the raising and lowering of the slide block 11.

[0013] The aforementioned balancing force adjustment apparatus 6 will be discussed subsequently. In the aforementioned balancing force generation apparatus 8, the torsional spring 10, which is obtained by processing a spring plate of a specified width to a helical shape, is installed inside the torsional spring housing tube 9, which is suspended from the balancing force adjustment apparatus 6 in a vertical arrangement, and the rotating working element 13, which effects rotation around the vertical axis in the same position by upward and downward movement of the aforementioned spiral lever 12, is installed in the bottom end of the torsional spring 10. The slit hole 13a, which corresponds to the cross-sectional shape of the torsional spring 10, is formed in the central part of the aforementioned rotating working element 13. When the aforementioned spiral lever 12, which passes through the slit hole 13a, is raised and lowered accompanying the upward and downward movement of the pane 3, the aforementioned rotating working element 13, which is guided to the torsional face of the spiral lever 12, rotates and the torsional spring 10 is tightly wound or unwound.

[0014] In actuality, the rotating working element 13 is rotated in the winding direction and the torsional spring 10 is wound tight accompanying the

lowering of the aforementioned spiral lever 12 while the rotating working element 13 is rotated in the opposite direction and the torsional spring 10 is unwound accompanying elevation of the pane 3. Consequently, when a balancing torsional force is applied to the aforementioned torsional spring 10 in advance in the position of maximum elevation of the pane 3, the torsional spring 10 can be balanced with the pane 3 in any position of elevation or lowering of the pane 3. Thus, the pane can be stopped at any desired open position and the pane 3 can be raised and lowered with very slight force because forces in the vertical direction are in equilibrium.

[0015] The aforementioned torsional spring housing tube 9 is a tubular body that has a length essentially corresponding to the vertical frame of the pane 3. It is suspended from the balancing force adjustment apparatus 6 that is affixed and positioned at the top. By means of adjustments in this balancing force adjustment apparatus, the introduction of an initial balancing force and subsequent adjustment of the balancing force by the torsional spring 10 can be effected by rotating the vertical shaft as the rotation center together with the torsional spring 10 which is installed inside.

[0016] The aforementioned balancing force adjustment apparatus 6, as shown in Figure 5, is an apparatus that is comprised of the case 20, which houses various structural components, the horizontal gear component 23, which is installed in a specified position inside the case so that it rotates freely around a horizontal axis, the spring component 24, which is inserted into the throughhole of the horizontal gear component 23, the balancing force adjustment component

25 that is inserted into the throughhole of the horizontal gear component 23, which is energized and held outwards by the aforementioned spring component 24, which also serves as a locking mechanism of the aforementioned horizontal gear component 23 and which introduces and adjusts the balancing force, and of the vertical gear component 26 that is installed in a specified position in the aforementioned case 20 so that it rotates freely around the vertical shaft and which is installed so that it engages with the aforementioned horizontal gear component 23, by which means it is rotated passively by the rotation of the aforementioned horizontal gear component 23. The connecting shaft 26d of the aforementioned vertical gear component 26 that projects below the case 20 is inserted into the aforementioned torsional spring housing tube 9 and these are connected by the connecting bolt 14 that is inserted through the connecting shaft 26d, the torsional spring housing tube 9 and the torsional spring 10.

[0017] We shall now present a detailed discussion of the aforementioned balancing force adjustment apparatus 6 on the basis of Figure 5 through Figure 9. The case 20, as shown in Figure 6, is a case that separates into two halves. One half of the case, 20A, and the other half of the case, 20B, are joined facing each other and the two halves are made into a single body by screws that are screwed into the screw holes 22a and 22b. The half pieces 20A and 20B of the case contain insert holes that are formed in the faces that are joined. Because they have a symmetrical structure, we shall describe one of the half pieces 20A of the case.

[0018] The insertion hole 21a for inserting the affixing screws for affixing the balancing force adjustment apparatus 6 to the vertical pieces 2A and 2B is formed in the joining face of the half piece 20A of the case along the horizontal direction in the upper part of this piece. In order to insert the aforementioned horizontal gear component 23 along the horizontal direction in essentially the center position, a first insert hole 21c in which is inserted the head 23A of the aforementioned horizontal gear component 23 which is of a relatively large diameter and which is made semicircular in cross section and a second insert hole 21d for the horizontal gear in which is set the shaft 23B of the aforementioned gear component 23 are formed so that they connect in the horizontal direction. Further, the head 25a of the aforementioned balancing force adjustment component 25 that is connected to the first insert hole 21c is inserted on the opposite side of the first insert hole 21c for the aforementioned horizontal gear and the engagement hole 21b for the lock which is hexagonal in cross section is formed for the purpose of holding the horizontal gear component 23 so that it cannot rotate.

[0019] In order to insert the aforementioned vertical gear component 26 along the vertical direction below the insert holes 21c and 21d for the horizontal gear, a first insert hole 21e for the vertical gear in which is inserted the head 26b of the aforementioned vertical gear component 26, which is of a relatively large diameter and which is made semicircular in cross section, and a second insert hole 21f for the vertical gear in which is inserted the shaft 26c of the aforementioned vertical gear 26, which is of a relatively large diameter and which

is made semicircular in cross section, are formed so that they connect in the vertical direction.

[0020] The aforementioned horizontal gear component 23, as shown in Figure 7, is a component that is constructed of the head 23A, which has the gear 23a, and of the shaft 23B that is connected to it. A hole of a shape such that the aforementioned balancing force adjustment component 25, i.e., the head throughhole 23b that is circular in cross section, is formed by the end face of the aforementioned head 23 and the shaft throughhole 23c that is connected to the aforementioned shaft 23B via the head throughhole 23b and that is of a polygonal shape, in this case a tetragonal shape, is formed. The aforementioned balancing force adjustment component 25 is inserted into these throughholes 23c and 23d, and, by rotating the balancing force adjustment component 25 around the shaft core, the horizontal gear component 23 is rotated at the same time. Further, the aforementioned gear 23a is formed along the circumferential direction in the step difference part of the head 23A and the shaft 23B.

[0021] The aforementioned balancing for adjustment component 25, as shown in Figure 8, is a bolt-shaped component that is comprised of the hexagonal head 25a, the circular guard 25, which is adjacent and of comparatively large diameter, and the shaft 25c, which is of a tetragonal shape in cross section. The groove 25d, which links with the tip end of the screwdriver, is formed on the top face of the aforementioned head 25a.

[0022] In the assembly of the aforementioned horizontal gear component 23 and the aforementioned balancing force adjustment component 25, when the

spring component 24 has been inserted into the insertion hole 23c of the horizontal gear component 23, the balancing force adjustment component 25 is inserted into the throughholes 23b and 23c of the horizontal gear component 23 from the shaft side 25 so that it engages in the insert holes 21c and 21d of the case 20 for the horizontal gear. The hexagonal head 25a of the aforementioned balancing force adjustment component 25 is energized outwards by the elastic force of the spring component 24 and is engaged in the engagement hole 21b for locking the case 21, with the horizontal gear component 23 being held so that it cannot rotate around the core shaft. The guard 25b of the aforementioned balancing force adjustment component 25 is for the purpose of preventing the balancing adjustment component 25 from being pulled out of the aforementioned engagement hole 21b for the lock.

[0023] The aforementioned vertical gear component 26 is a component that is comprised of the head 26b, which has the gear 26a in the periphery of the top face, the shaft 26c, which is adjacent to the head, and the connecting shaft 26d, which is connected to the shaft 26c, and is inserted in insert holes 21e and 21f of the case 20 for the aforementioned vertical gear. The aforementioned gear component 23a of the horizontal gear component 23 and the aforementioned gear component 26a of the vertical gear component 26 engage with each other, the rotation of the horizontal gear component 23 is transmitted to the vertical gear component 26 and the vertical gear component 26 is rotated passively around the shaft core.

[0024] In order to introduce the initial torsional force to the torsional spring 10 in the balancing force adjustment apparatus 6 that is constructed in this way at the time of installation of the double-hung window 1, as shown in Figure 5, the tip end of the screwdriver 30 is applied to the head 25a of the aforementioned balancing force adjustment component 25, the balancing force adjustment component 25 is pushed inside against the resistance of the energizing force and the head 25a is rotated around the shaft core in a state in which it is positioned in the head throughhole 23b of the horizontal gear component 23. When the balancing force adjustment component 25 is rotated around the shaft core, the horizontal gear component 23 rotates around the core shaft coaxially, the rotation of the horizontal gear component 23 is transmitted to the aforementioned vertical gear component 26 which is arranged perpendicular to it and the vertical gear component 26 is rotated around the shaft core. As a result of the rotation of the connecting shaft 26d of the vertical gear component 26, the torsional spring housing tube 9 and the torsional spring 10 are rotated in the direction of tight winding of the aforementioned torsional spring 10 and a balancing force is applied to the torsional spring 10. When the introduction of a specified balancing force is completed, the screwdriver 30 is separated from the balancing force adjustment component 25, the balancing force adjustment component 25 is energized outward by the elastic force of the inserted spring component 24, the head 25a is engaged in the engagement hole 21b for locking the case 20 and the horizontal gear component 23 is held so that it cannot rotate around the shaft core. As a result, the vertical gear component 26, which is engaged in the

horizontal gear component 23, is at the same time also held so that it cannot rotate and is maintained in this state with the torsional force that is applied to the torsional spring 10 not being relaxed.

[0025] In this example, the gear 23a of the horizontal gear component 23 and the gear 26a of the vertical gear component 26 that are arranged perpendicular to each other were formed on orthogonal faces. However, the engaging faces can also be conical faces as in bevel gears. Further, in the relationship in which the balancing force generation apparatus 8 is held suspended in the balancing force adjustment apparatus 6, the connecting shaft 26d of the vertical gear component 26 is connected to the torsional spring housing tube 9 and the torsional spring 10, and the torsional spring housing tube 9 also rotates together with the torsional spring 10 due to the rotation of the vertical gear component 26. For example, the torsional spring housing tube may be supported separately and the aforementioned connecting shaft 26d and the torsional spring 10 may be connected so that only the torsional spring 10 is rotated by the rotation of the vertical gear component 26.

[0026]

[Effect of the invention] By means of this invention as described in detail above, painful operating postures are not intensified, the adjustment of balancing force can be performed easily, and, following adjustment, tight winding and unwinding adjustments can be performed simply without producing slackness and slipping. Further, stepwise adjustment is possible for both tight winding and unwinding.

[Brief Explanation of the Figures]

[Figure 1] This is a frontal view of the double-hung window 1 equipped with the balancing apparatus 5.

[Figure 2] This is a structural diagram of the balancing apparatus 5.

[Figure 3] This is a view along line III-III in Figure 1.

[Figure 4] This is a view along line IV-IV in Figure 1.

[Figure 5] This is an enlarged cross-sectional view of the balancing force adjustment apparatus 6.

[Figure 6] This is an exploded view of the balancing force adjustment apparatus 6.

[Figure 7] This shows the horizontal gear component 23. (A) is a side view, (B) is a frontal view and (C) is a bottom view.

[Figure 8] This shows the balancing force adjustment component 25. (A) is a side view, (B) is a frontal view and (C) is a bottom view.

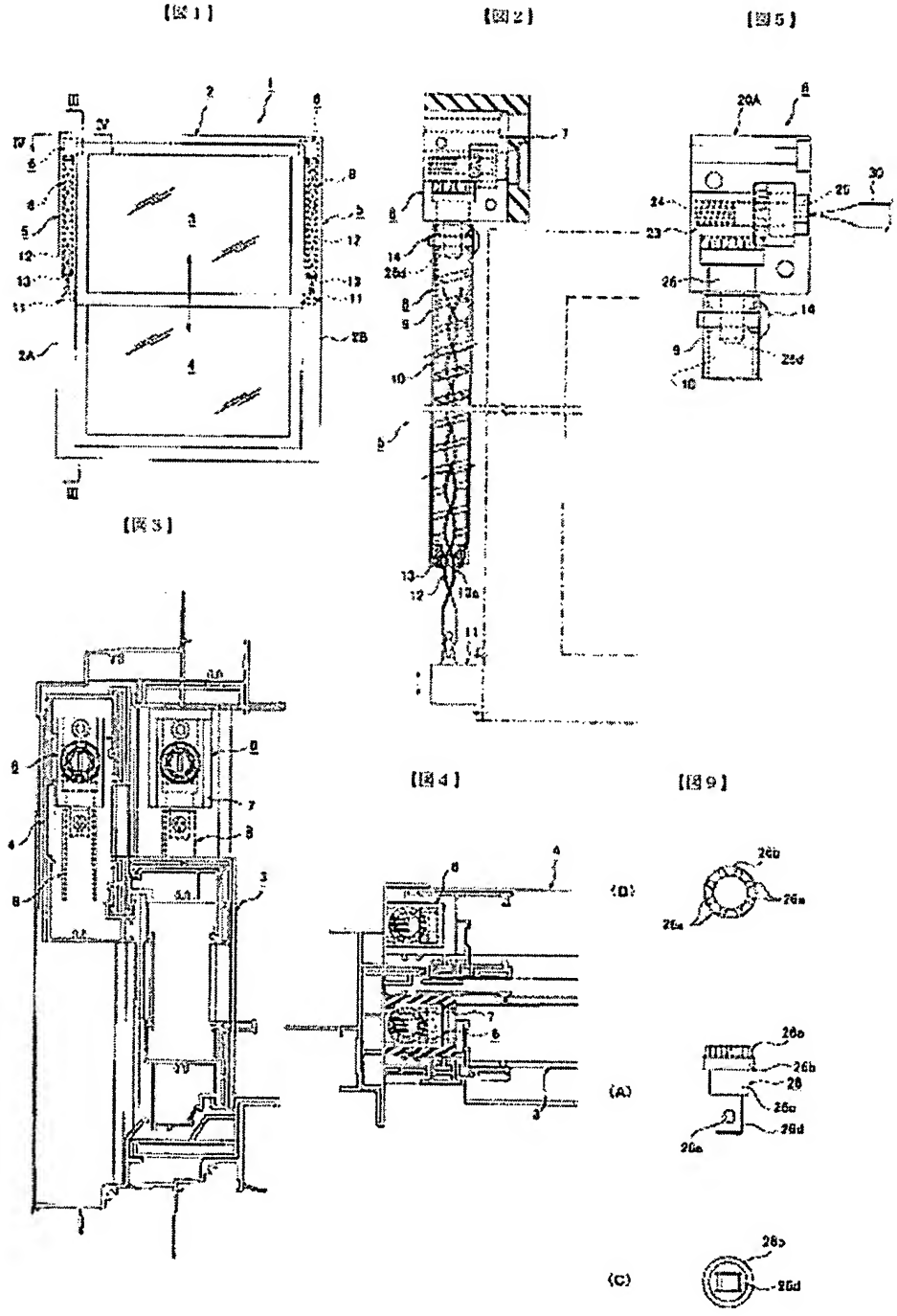
[Figure 9] This shows the vertical gear component 26. (A) is a side view, (B) is a plane view and (C) is a bottom view.

[Explanation of the Symbols]

1 – double-hung window; 2A and 2B – vertical frame pieces; 3 – inner pane; 4 – outer pane; 5 – balancing apparatus; 6 – balancing force adjustment apparatus; 7 – stop; 8 – balancing force generation apparatus; 9 – torsional spring housing tube; 10 – torsional spring; 11 – slide block; 12 – spiral lever; 13 – rotating

working element; 14 – connecting bolt; 20 – case; 23 – horizontal gear component; 23a – gear; 24 – spring component; 25 – balancing force adjustment component; 26 – vertical gear component; 26a – gear

[図 = Figure]



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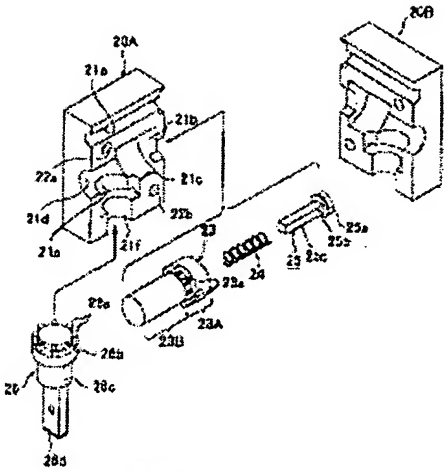

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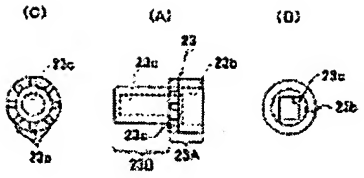

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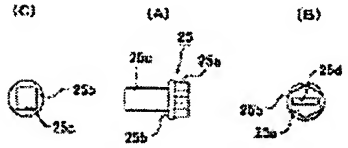

[Amendment, bottom of page 7]

[Amendment]

[Date Submitted] 29 November 1999

[Amendment 1]

[Title of Amended Document] Specification

[Name of Amended Item] Claims

[Method of Amendment] Change

[Content of Amendment]

[Claims]

[Claim 1] A balancing apparatus for double-hung windows characterized in that it is a balancing apparatus that is installed in movable panes that open and close in the vertical direction, for the purpose of maintaining the weight and mechanical equilibrium relationship of said movable pane and stopping the movable pane in any desired position and of simplifying the opening and closing operations,

in that the aforementioned balancing apparatus is constructed of a balancing force generation apparatus that is comprised of a balancing force adjustment apparatus that is affixed and arranged in a position above the vertical frame pieces,

a balancing force generation apparatus that is comprised of a torsional spring housing tube, a torsional spring that is housed inside it and a rotating working element that is installed in the bottom end part of the torsional spring, a balancing force generation apparatus that is connected to the aforementioned balancing force adjustment apparatus and is installed in a vertical arrangement, which rotates around at least the torsional spring shaft core due to adjustment operations in the balancing force adjustment apparatus, with which the introduction and adjustment of balancing force on the torsional spring is possible

and which provides a balancing force in the upward direction on the movable pane due to the aforementioned torsional spring when the movable pane is opened and closed,

a slide unit that is affixed on the lower end of the aforementioned movable pane and that rises and falls accompanying the vertical movement of the movable pane,

and a spiral lever which is affixed at the bottom end of the slide block, the top end part of which passes through the rotating working element of the balancing force generation apparatus and is inserted into the interior of the torsional spring housing tube, which exerts a winding tight action and a winding back or unwinding action on the torsional spring by applying rotational force around the perpendicular axis on the aforementioned rotating working element accompanying vertical movement of the movable pane.

[Claim 2] A balancing apparatus for double-hung windows as described in claim 1 in which the aforementioned balancing force adjustment apparatus is comprised of a case,

a horizontal gear component that is arranged in a specified position in the case so that it rotates freely around a horizontal axis, which is constructed of a head part and a shaft part, which is provided with a gear in the periphery of the step

difference part between the aforementioned head part and shaft part, in which a circular throughhole is formed by the end face of the aforementioned head part and in which a polygonal throughhole that is connected to the circular throughhole and that extends into the shaft part is formed,

a spring component that is inserted into the aforementioned polygonal throughhole of the horizontal gear component,

a balancing force adjusting component [Note: 25 is omitted] that is comprised of a polygonal head part, a guard part that is adjacent to the polygonal head part and that is of large diameter and a shaft part, which is polygonal in cross section and which fits into the polygonal throughhole of the aforementioned horizontal gear part, which is inserted and arranged in the throughhole of the aforementioned horizontal gear component, which is energized and held outwards by the aforementioned spring component, which cannot rotate due to engagement with a lock stophole that is formed in the case when in a protruded state, which stops the rotation of the aforementioned horizontal gear component, which permits rotation around the shaft core together with the aforementioned horizontal gear component only at times of a state in which it is pushed in opposition to the aforementioned energizing force and which applies rotation to the aforementioned horizontal gear component,

and of a vertical gear component which is arranged in a specified position in the aforementioned case so that it rotates freely around the vertical axis, which is equipped with a gear in the top part that engages with the aforementioned horizontal gear component, which is equipped with a linking shaft on the lower end and which is arranged so that it engages with the aforementioned horizontal gear component and which is rotated passively by the rotation of the aforementioned horizontal gear component, and in that the linking shaft of the aforementioned vertical gear component is connected at least to the torsional spring of the aforementioned balancing force generation apparatus.

[Amendment 2] [page 8]

[Title of Amended Document] Specification

[Name of Amended Item] 0007

[Method of Amendment] Change

[Content of Amendment]

[0007]

[Means for solving the problems] This invention, which is for the purpose of solving the aforementioned problems, is characterized in that it is a balancing apparatus that is installed in movable panes that open and close in the vertical direction, for the purpose [Note: "for the purpose" is added] of maintaining the weight and mechanical equilibrium relationship of said movable pane, and can

stop the movable pane in any desired position and that simplifies the opening and closing operations, in that the aforementioned balancing apparatus is constructed of a balancing force generation apparatus that is comprised of a balancing force adjustment apparatus that is affixed and arranged in a position above vertical frame pieces, a torsional spring housing tube, a torsional spring that is housed inside it and a rotating working element that is installed in the bottom end part of the torsional spring, which is connected to the aforementioned balancing force adjustment apparatus and is installed in a vertical arrangement, which rotates around at least the torsional spring shaft core due to adjustment operations in the balancing force adjustment apparatus, with which the introduction and adjustment of balancing force on the torsional spring is possible, and which provides a balancing force in the upward direction on the movable pane due to the aforementioned torsional spring when the movable pane is opened and closed, a slide unit that is set in the lower end of the aforementioned movable pane and that rises and falls accompanying the vertical movement of the movable pane and a spiral lever which is affixed to the bottom end of the slide block, the top end part of which passes through the rotating working element of the balancing force generation apparatus and is inserted into the interior of the torsional spring housing tube, which exerts a winding tight action and a winding back or unwinding action on the torsional spring by applying rotational force around the perpendicular axis on the aforementioned rotating working element accompanying vertical movement of the movable pane.

[Amendment 3] [page 8]

[Title of Amended Document] Specification

[Name of Amended Item] 0008

[Method of Amendment] Change

[Content of Amendment]

[0008] Specifically, the structure of the aforementioned balancing force adjustment apparatus can be a structure in which a case, a horizontal gear component that is arranged in a specified position in the case so that it rotates freely around a horizontal axis, which is constructed of a head part and a shaft part, which is provided with a gear in the periphery of the step difference part between the aforementioned head part and shaft part, in which a circular throughhole is formed by the end face of the aforementioned head part and in which a polygonal throughhole that is connected to the circular throughhole and that extends into the shaft part is formed, a spring component that is inserted into the aforementioned polygonal throughhole of the horizontal gear component, a balancing force adjusting component that is comprised of a polygonal head part, a guard part that is adjacent to the polygonal head part and that is of large diameter and a shaft part, which is polygonal in cross section and which fits into the polygonal throughhole of the aforementioned horizontal gear part, in that it is inserted and arranged in the throughhole of the aforementioned horizontal gear component, which is comprised of a balancing force adjusting component, which

is energized and held outwards by the aforementioned spring component, which cannot rotate due to engagement with a lock stophole that is formed in the case when in a protruded state, which stops the rotation of the aforementioned horizontal gear component which permits rotation around the shaft core together with the aforementioned horizontal gear component only at times of a state in which it is pushed in opposition to the aforementioned energizing force and which applies rotation to the aforementioned horizontal gear component, and of a vertical gear component, that is arranged in specified position in the aforementioned case so that it rotates freely around the vertical axis, which is equipped with a gear in the top part that engages with the aforementioned horizontal gear component, which is equipped with a linking shaft on the lower end and [Note: "and which is arranged...component" is omitted here.] which is rotated passively by the rotation of the aforementioned horizontal gear component and in which the linking shaft of the aforementioned vertical gear component is connected at least to the torsional spring of the aforementioned balancing force generation apparatus. Further, the stop that forms the top position of the movable pane may be set on the outer side of the case of the aforementioned balancing force adjustment apparatus.

[Amendment heading at bottom of page 8]

[Amendment]

[Date Submitted] 1 November 2000

[Amendment 1]

[Title of Amended Document] Specification

[Name of Amended Item] Entire text

[Method of Amendment] Change

[Content of Amendment]

[Title of Document] Specification

Title of the Invention] A Balancing Apparatus for Double-Hung Windows

[Claims]

[Claim 1] A balancing apparatus for double-hung windows characterized in that it is a balancing apparatus that is installed in movable panes that open and close in the vertical direction, for the purpose of maintaining the weight and mechanical equilibrium relationship of said movable pane and stopping the movable pane in any desired position and of simplifying the opening and closing operations,

in that the aforementioned balancing apparatus is constructed of a balancing force generation apparatus that is comprised of a balancing force adjustment apparatus that is affixed and arranged in a position above the vertical frame pieces,

a balancing force generation apparatus that is comprised of a torsional spring housing tube, a torsional spring that is housed inside a torsional spring housing tube and a rotating working element that is installed in the bottom end part of the torsional spring, a balancing force generation apparatus that is connected to the aforementioned balancing force adjustment apparatus and is installed in a vertical arrangement, which rotates around at least the torsional spring shaft core due to adjustment operations in the balancing force adjustment apparatus, with which the introduction and adjustment of balancing force on the torsional spring is possible and which provides a balancing force in the upward direction on the movable pane due to the aforementioned torsional spring when the movable pane is opened and closed,

a slide unit that is affixed on the lower end of the aforementioned movable pane and that rises and falls accompanying the vertical movement of the movable pane,

and a spiral lever which is affixed at the bottom end of the slide block, the top end part of which passes through the rotating working element of the balancing

force generation apparatus and is inserted into the interior of the torsional spring housing tube, which exerts a winding tight action and a winding back or unwinding action on the torsional spring by applying rotational force around [Note: incorrect character amended] the perpendicular axis on the aforementioned rotating working element accompanying vertical movement of the movable pane.

[Claim 2] A balancing apparatus for double-hung windows as described in claim 1 in which the aforementioned balancing force adjustment apparatus is comprised of a case, a horizontal gear component that is installed in a specified position in the case so that it rotates freely around the horizontal shaft and that is equipped with a gear, and a vertical gear component that is installed in a specified position in the aforementioned case so that it rotates freely around the vertical shaft, and which is provided with a gear that engages with the gear of the aforementioned horizontal gear component and that is rotated passively by rotation of the aforementioned horizontal gear component and in which the aforementioned vertical gear component is connected to at least one torsional spring of the aforementioned balancing force generation apparatus.

[Claim 3] A balancing apparatus for double-hung windows as described in either of claims 1 or 2 in which the aforementioned balancing force adjustment apparatus is comprised of a case,

a horizontal gear component that is arranged in a specified position in the case so that it rotates freely around [NOTE: correction of incorrect character by amendment] a horizontal axis, which is constructed of a head part and a shaft part, which is provided with a gear in the periphery of the step difference part between the aforementioned head part and shaft part, in which a circular throughhole is formed by the end face of the aforementioned head part and in which a polygonal throughhole that is connected to the circular throughhole and that extends into the shaft part is formed,

a spring component that is inserted into the aforementioned polygonal throughhole of the horizontal gear component, a balancing force adjustment component that is comprised of a polygonal head part, a guard part that is adjacent to the polygonal head part and that is of large diameter and a shaft part, which is polygonal in cross section and which fits into the polygonal throughhole of the aforementioned horizontal gear part, which is inserted and arranged in the throughhole of the aforementioned horizontal gear component, which is energized and held outwards by the aforementioned spring component, which cannot rotate due to engagement with a lock stophole that is formed in the case when in a protruded state, which stops the rotation of the aforementioned horizontal gear component, which permits rotation around [NOTE: incorrect character corrected by amendment] the shaft core together with the aforementioned horizontal gear component only at times of a state in which it is pushed in opposition to the aforementioned energizing force of the spring

component and which applies rotation to the aforementioned horizontal gear component,

and of a vertical gear component which is arranged in a specified position in the aforementioned case so that it rotates freely around the vertical axis, which is equipped with a gear in the top part that engages with the aforementioned horizontal gear component, which is equipped with a linking shaft on the lower end, [NOTE: comma inserted by amendment here in the Japanese text] and which is arranged so that it engages with the aforementioned horizontal gear component and which is rotated passively by the rotation of the aforementioned horizontal gear component, and in that the linking shaft of the aforementioned vertical gear component is connected at least to the torsional spring of the aforementioned balancing force generation apparatus.

[Claim 4] A balancing apparatus for double-hung windows as described in any of claims 1 to 3 in which the stop that controls [NOTE: "forms" replaced by "controls by amendment] the top position of the movable pane is set on the outer side of the case of the aforementioned balancing force adjustment apparatus.

[Detailed Description of the Invention]

[0001]

[Technological field of the invention] This invention relates to a balancing apparatus for double-hung windows that is equipped onto a movable pane that opens and closes in the vertical direction.

[0002]

[Prior art] In double-hung windows in which a pane is opened in the vertical direction, a balancing apparatus is used that maintains the pane weight and mechanical equilibrium relationship in regard to the aforementioned pane so that the pane can be moved upwards or downwards simply by a slight force and for the purpose of stopping it in any desired position. This balancing apparatus is an apparatus that uses the torsional force of a torsional spring to act on a spiral lever. Known instances are described in Japanese Patent Application Early Disclosure No. 3 [1991] -161,683, Japanese Patent Application Early Disclosure No. 3 [1991] -180,683 and Japanese Patent Application Early Disclosure No. 4 [1992] -238,984. These inventions relate primarily to adjustment of the torsional force of the aforementioned torsional springs. Specifically, adjustment mechanisms that have been proposed conventionally can be generally divided into devices in which an adjustment shaft that is installed in a slide apparatus is rotated in one direction only by a ratchet mechanism and devices in which a coiled brake spring is wound around the adjustment axis and a braking force is applied to the adjustment shaft by tight binding force.

[0003]

[Problems the invention is intended to solve] Although adjustment structures based on the aforementioned ratchet structure provide extremely good

conditions for tight closing of torsional springs, there is the drawback that they cannot be wound back, for which reason adjustment is limited to one direction. On the other hand, devices using brake springs are superior to the aforementioned ratchet mechanism in that both tight closing and unwinding are possible. However, there are the problems that the braking force by the brake spring is not secure, that unwinding occurs spontaneously due to slipping and that a sufficient braking function cannot be maintained over long periods because loosening occurs over the course of time. Moreover, there is the further problem that the adjustment shaft must be rotated against the resistance of the brake spring so that a great effort must be expended in adjustment.

[0004] By comparison to these ratchet structures and brake structures, the balancing apparatus described in Japanese Patent Application Early Disclosure No. 4 [1992] -238,984 is superior to the other devices in that a reliable braking force is obtained using the wedge effect of the direction of rotation of the adjustment shaft and that unwinding can be performed simply. However, there are the problems that there is a large number of parts, making the structure of the braking part complex, and that adjustment cannot be made in steps during unwinding.

[0005] Further, in the method of adjusting the balancing force that provides rotation to the torsional spring in these balancing apparatuses, a spiral lever is connected to the adjustment shaft, which is installed in a slide apparatus so that it rotates freely around [NOTE: incorrect character corrected by amendment] the vertical shaft, a device such as a screw is introduced into a +

shape groove that is formed in the bottom face of the adjustment shaft the screwdriver, for which reason there is the problem that that the adjustment operation is difficult because a painful operating posture is intensified.

[0006] The principal object of this invention is to provide a balancing apparatus for double-hung windows whereby the painful operating posture is not intensified, adjustment of the balancing force can be performed easily, winding tight and unwinding can be performed simply after adjustment without occurrence of relaxation and slipping, and winding tight can be performed in steps in relation to unwinding.

[0007]

[Means for solving the problems] This invention, which is for the purpose of solving the aforementioned problems, is characterized in that it is a balancing apparatus that is installed in movable panes that open and close in the vertical direction, for the purpose of maintaining the weight and mechanical equilibrium relationship of said movable pane, stopping the movable pane in any desired position and simplifying the opening and closing operations, in that the aforementioned balancing apparatus is constructed of a balancing force generation apparatus that is comprised of a balancing force adjustment apparatus that is affixed and arranged in a position above vertical frame pieces, a torsional spring housing tube, a torsional spring that is housed inside a torsional spring housing tube and a rotating working element that is installed in the bottom end part of the torsional spring, which is connected to the aforementioned balancing force adjustment apparatus and is installed in a

vertical arrangement, which rotates around at least the torsional spring shaft core due to adjustment operations in the balancing force adjustment apparatus, with which the introduction and adjustment of balancing force on the torsional spring is possible, and which provides a balancing force in the upward direction on the movable pane due to the aforementioned torsional spring when the movable pane is opened and closed, a slide unit that is set in the lower end of the aforementioned movable pane and that rises and falls accompanying the vertical movement of the movable pane and a spiral lever which is affixed at the bottom end of the slide block, the top end part of which passes through the rotating working element of the balancing force generation apparatus and is inserted into the interior of the torsional spring housing tube, which exerts a winding tight action and a winding back or unwinding action on the torsional spring by applying rotational force around [incorrect character amended] the perpendicular axis on the aforementioned rotating working element accompanying vertical movement of the movable pane.

[0008] In this case, the balancing apparatus for double-hung windows can have a structure in which it is comprised of a case, a horizontal gear component that is installed in a specified position in the case so that it rotates freely around the horizontal shaft and that is equipped with a gear, and a vertical gear component that is installed in a specified position in the aforementioned case so that it rotates freely around the vertical axis, and that is provided with a gear that engages with the gear of the aforementioned horizontal gear component and that is rotated passively by rotation of the aforementioned horizontal gear component

and in which the aforementioned vertical gear component is connected to at least one torsional spring of the aforementioned balancing force generation apparatus.

[0009] A more specific and preferable structure of the aforementioned balancing force adjustment apparatus can be a structure in which a case, a horizontal gear component that is arranged in a specified position in the case so that it rotates freely around [NOTE: correction of incorrect character by amendment] a horizontal axis, which is constructed of a head part and a shaft part, which is provided with a gear in the periphery of the step difference part between the aforementioned head part and shaft part, in which a circular throughhole is formed by the end face of the aforementioned head part and in which a polygonal throughhole that is connected to the circular throughhole and that extends into the shaft part is formed, a spring component that is inserted into the aforementioned polygonal throughhole of the horizontal gear component, a balancing force adjustment component that is comprised of a polygonal head part, a guard part that is adjacent to the polygonal head part and that is of large diameter and a shaft part, which is polygonal in cross section and which fits into the polygonal throughhole of the aforementioned horizontal gear part, in that it is inserted and arranged in the throughhole of the aforementioned horizontal gear component, which is comprised of a balancing force adjusting component, which is energized and held outwards by the aforementioned spring component, which cannot rotate due to engagement with a lock stophole that is formed in the case when in a protruded state, which stops the rotation of the aforementioned horizontal gear component, which permits rotation around [NOTE: correction of

incorrect character by amendment] the shaft core together with the aforementioned horizontal gear component only at times of a state in which it is pushed in opposition to the aforementioned energizing force of the spring component and which applies rotation to the aforementioned horizontal gear component, and of a vertical gear component, that is arranged in specified position in the aforementioned case so that it rotates freely around [NOTE: incorrect character corrected by amendment] the vertical axis, which is equipped with a gear in the top part that engages with the aforementioned horizontal gear component, which is equipped with a linking shaft on the lower end, [NOTE: comma inserted by amendment here in the Japanese text] and which is rotated passively by the rotation of the aforementioned horizontal gear component and in which the linking shaft of the aforementioned vertical gear component is connected at least to the torsional spring of the aforementioned balancing force generation apparatus. Further, the stop that forms the top position of the movable pane may be set on the outer side of the case of the aforementioned balancing force adjustment apparatus.

[0010] In this invention, the balancing force adjustment apparatus is installed on the top side of the balancing force generation apparatus so that torsional force can be applied directly at the top to rotate the torsional spring of the aforementioned balancing generating apparatus. Consequently, the aforementioned working adjustment component that stands beside and is exposed to the double-hung window can operate simply for introduction and adjustment of the initial torsional force simply by rotation by means of a device

such as a screwdriver. In addition, torsional force is applied by rotation of a gear component and rotation of the gear component can be released from a stopped state simply by pushing in. For this reason, tight closing and unwinding adjustments can be performed simply and there is no occurrence of slackness or slipping after adjustment. Moreover, there are the advantages that tight winding can be adjusted in steps relative to unwinding and that the operator can introduce and adjust the torsional force from the horizontal direction while standing.

[0011] [Embodiment of the invention] We shall now present a detailed description of the embodiment of this invention by reference to the figures. Figure 1 is a frontal view of the double-hung window 1 equipped with the balancing apparatus 5 and Figure 2 is a structural diagram of the balancing apparatus 5.

[0012] The double-hung window 1 is equipped with the inner pane 3 and the outer pane 4 that are raised and lowered freely inside the window frame 2 along the vertical frame pieces 2A and 2B. The aforementioned panes 3 and 4 can be held in any desired position by the balancing apparatuses 5 and 5 that are installed along the aforementioned vertical frame pieces 2A and 2B. The aforementioned balancing apparatuses 5 are installed with the inner pane 3 and the outer pane 4. The two differ only in the lengthwise dimensions of the torsional spring housing tube 9, the torsional spring 10 and the spiral lever 12, to be described subsequently, and in that the stop 7, which is freely attached and detached, is installed on the outer side of the balancing apparatus 5 only for the

inner pane 3. Because their basic structures are the same, only the inner pane 3 (hereafter referred to simply as pane) is described.

[0013] The aforementioned balancing apparatus 5, as shown in detail in Figure 2, is affixed and arranged above the vertical frame pieces 2A and 2B and is comprised of the balancing force adjustment apparatus 6 for adjustment of the balancing force, the balancing force generation apparatus 8 which is installed connected to the balancing force adjustment apparatus 6, which is equipped with the torsional spring 10 inside the torsional spring housing tube 9 and which provides a balancing force in the upwards direction essentially on the pane 3, the slide block 11, which is affixed in the lower frame side of the pane 3 and which is raised and lowered with the pane 3, and, for the purpose of actively linking the slide block 11 and the aforementioned balancing force generation apparatus 8, the spiral lever 12 which connects the lower end with the aforementioned slide block 11, the top end of which is inserted into the interior from the bottom end face of the aforementioned balancing force generation apparatus 8 and which winds tight/unwinds the torsional spring 10 that is installed inside the aforementioned balancing force generation apparatus 8 accompanying the raising and lowering of the slide block 11.

[0014] The aforementioned balancing force adjustment apparatus 6 will be discussed subsequently. In the aforementioned balancing force generation apparatus 8, the torsional spring 10, which is obtained by processing a spring plate of a specified width to a helical shape, is installed inside the torsional spring housing tube 9, which is suspended from the balancing force adjustment

apparatus 6 in a vertical arrangement, and the rotating working element 13, which effects rotation around [NOTE: Incorrect character corrected by amendment] the vertical axis in the same position by upward and downward movement of the aforementioned spiral lever 12, is installed in the bottom end of the torsional spring 10. The slit hole 13a, which corresponds to the cross-sectional shape of the torsional spring 10, is formed in the central part of the aforementioned rotating working element 13. When the aforementioned spiral lever 12, which passes through the slit hole 13a, is raised and lowered accompanying the upward and downward movement of the pane 3, the aforementioned rotating working element 13, which is guided to the torsional face of the spiral lever 12, rotates and the torsional spring 10 is tightly wound or unwound.

[0015] In actuality, the rotating working element 13 is rotated in the winding direction and the torsional spring 10 is wound tight accompanying the lowering of the aforementioned spiral lever 12 while the rotating working element 13 is rotated in the opposite direction and of the torsional spring 10 is unwound accompanying elevation of the pane 3. Consequently, when a balancing torsional force is applied to the aforementioned torsional spring 10 in advance in the position of maximum elevation of the pane 3, the torsional spring 10 can be balanced with the pane 3 in any position of elevation or lowering of the pane 3. Thus, the pane can be stopped at any desired open position and the pane 3 can be raised and lowered with very slight force because forces in the vertical direction are in equilibrium.

[0016] The aforementioned torsional spring housing tube 9 is a tubular body that has a length essentially corresponding to the vertical frame of the pane 3. It is suspended from the balancing force adjustment apparatus 6 that is affixed and positioned at the top. By means of adjustments in this balancing force adjustment apparatus, the introduction of an initial balancing force and subsequent adjustment of the balancing force by the torsional spring 10 can be effected by rotating the vertical shaft as the rotation center together with the torsional spring 10 which is installed inside.

[0017] The aforementioned balancing force adjustment apparatus 6, as shown in Figure 5, is an apparatus that is comprised of the case 20, which houses various structural components, the horizontal gear component 23, which is installed in a specified position inside the case so that it rotates freely around a horizontal axis, the spring component 24, which is inserted into the throughhole of the horizontal gear component 23, the balancing force adjustment component 25 that is inserted into the throughhole of the horizontal gear component 23, which is energized and held outwards by the aforementioned spring component 24, which also serves as a locking mechanism of the aforementioned horizontal gear component 23 and which introduces and adjusts the balancing force, and of the vertical gear component 26 that is installed in a specified position in the aforementioned case 20 so that it rotates freely around the vertical shaft and which is installed so that it engages with the aforementioned horizontal gear component 23, by which means it is rotated passively by the rotation of the aforementioned horizontal gear component 23. The connecting shaft 26d of the

aforementioned vertical gear component 26 that projects below the case 20 is inserted into the aforementioned torsional spring housing tube 9 and these are connected by the connecting bolt 14 that is inserted through the connecting shaft 26d, the torsional spring housing tube 9 and the torsional spring 10.

[0018] We shall now present a detailed discussion of the aforementioned balancing force adjustment apparatus 6 on the basis of Figure 5 through Figure 9. The case 20, as shown in Figure 6, is a case that separates into two halves. One half of the case, 20A, and the other half of the case, 20B, are joined facing each other and the two halves are made into a single body by screws that are screwed into [Note: Incorrect grammatical particle is corrected by amendment] the screw holes 22a and 22b. The half pieces 20A and 20B of the case contain insert holes that are formed in the faces that are joined. Because they have a symmetrical structure, we shall describe one of the half pieces, 20A of the case.

[0019] The insertion hole 21a for inserting the affixing screws for affixing the balancing force adjustment apparatus 6 to the vertical pieces 2A and 2B is formed in the joining face of the half piece 20A of the case along the horizontal direction in the upper part of this piece. In order to insert the aforementioned horizontal gear component 23 along the horizontal direction in essentially the center position, a first inset hole 21c in which is insert the head 23A of the aforementioned horizontal gear component 23 which is of a relatively large diameter and which is made semicircular in cross section and a second insert hole 21d for the horizontal gear in which is set the shaft 23B of the aforementioned gear component 23 are formed so that they connect in the

horizontal direction. Further, the head 25a of the aforementioned balancing force adjustment component 25 that is connected to the first insert hole 21c is insert on the opposite side of the first insert hole 21c for the aforementioned horizontal gear and the engagement hole 21b for the lock which is hexagonal in cross section is formed for the purpose of holding the horizontal gear component 23 so that it cannot rotate.

[0020] In order to insert the aforementioned vertical gear component 26 along the vertical direction below the insert holes 21c and 21d for the horizontal gear, a first insert hole 21e for the vertical gear in which is inserted the head 26b of the aforementioned vertical gear component 26, which is of a relatively large diameter and which is made semicircular in cross section, and a second inset hole 21f for the vertical gear in which is inserted the shaft 26c of the aforementioned vertical gear 26, which is of a relatively large diameter and which is made semicircular in cross section, are formed so that they connect in the vertical direction.

[0021] The aforementioned horizontal gear component 23, as shown in Figure 7, is a component that is constructed of the head 23A, which has the gear 23a, and of the shaft 23B that is connected to it. A hole of a shape such that the aforementioned balancing force adjustment component 25, i.e., the head throughhole 23b that is circular in cross section, is formed by the end face of the aforementioned head 23 and the shaft throughhole 23c that is connected to the aforementioned shaft 23B via the head throughhole 23b and that is of a polygonal shape, in this case a tetragonal shape, is formed. The aforementioned

balancing force adjustment component 25 is inserted into these throughholes 23c and 23d, and, by rotating the balancing force adjustment component 25 around [NOTE: incorrect character corrected by amendment] the shaft core, the horizontal gear component 23 is rotated at the same time. Further, the aforementioned gear 23a is formed along the circumferential direction in the step difference part of the head 23A and the shaft 23B.

[0022] The aforementioned balancing for adjustment component 25, as shown in Figure 8, is a bolt-shaped component that is comprised of the hexagonal head 25a, the circular guard 25, which is adjacent and of comparatively large diameter, and the shaft 25c, which is of a tetragonal shape in cross section. The groove 25d, which links with the tip end of the screwdriver, is formed on the top face of the aforementioned head 25a.

[0023] In the assembly of the aforementioned horizontal gear component 23 and the aforementioned balancing force adjustment component 25, when the spring component 24 has been inserted into the insertion hole 23c of the horizontal gear component 23, the balancing force adjustment component 25 is inserted into the throughholes 23b and 23c of the horizontal gear component 23 from the shaft side 25 so that it engages in the insert holes 21c and 21d of the case 20 for the horizontal gear. The hexagonal head 25a of the aforementioned balancing force adjustment component 25 is energized outwards by the elastic force of the spring component 24 and is engaged in the engagement hole 21b for locking the case 21, with the horizontal gear component 23 being held so that it cannot rotate around the core shaft. The guard 25b of the aforementioned

balancing force adjustment component 25 is for the purpose of preventing the balancing adjustment component 25 from being pulled out of the aforementioned engagement hole 21b for the lock.

[0024] The aforementioned vertical gear component 26 is a component that is comprised of the head 26b, which has the gear 26a in the periphery of the top face, the shaft 26c, which is adjacent to the head, and the connecting shaft 26d, which is connected to the shaft 26c, and is inset in insert holes 21e and 21f of the case 20 for the aforementioned vertical gear. The aforementioned gear component 23a of the horizontal gear component 23 and the aforementioned gear component 26a of the vertical gear component 26 engage with each other, the rotation of the horizontal gear component 23 is transmitted to the vertical gear component 26 and the vertical gear component 26 is rotated passively around [NOTE: incorrect character corrected by amendment] the shaft core.

[0025] In order to introduce the initial torsional force to the torsional spring 10 in the balancing force adjustment apparatus 6 that is constructed in this way at the time of installation of the double-hung window 1, as shown in Figure 5, the tip end of the screwdriver 30 is applied to the head 25a of the aforementioned balancing force adjustment component 25, the balancing force adjustment component 25 is pushed inside against the resistance of the energizing force and the head 25a is rotated around [NOTE: incorrect character corrected by amendment] the shaft core in a state in which it is positioned in the head throughhole 23b of the horizontal gear component 23. When the balancing force adjustment component 25 is rotated around [Note: incorrect character corrected

by amendment] the shaft core, the horizontal gear component 23 rotates around [NOTE: incorrect character corrected by amendment] the core shaft coaxially, the rotation of the horizontal gear component 23 is transmitted to the aforementioned vertical gear component 26 which is arranged perpendicular to it and the vertical gear component 26 is rotated around [NOTE: incorrect character corrected by amendment] the shaft core. As a result of the rotation of the connecting shaft 26d of the vertical gear component 26, the torsional spring housing tube 9 and the torsional spring 10 are rotated in the direction of tight winding of the aforementioned torsional spring 10 and a balancing force is applied to the torsional spring 10. When the introduction of a specified balancing force is completed, the screwdriver 30 is separated from the balancing force adjustment component 25, the balancing force adjustment component 25 is energized outward by the elastic force of the inserted spring component 24, the head 25a is engaged in the engagement hole 21b for the locking of the case 20 and the horizontal gear component 23 is held so that it cannot rotate around the shaft core. As a result, the vertical gear component 26, which is engaged in the horizontal gear component 23, is at the same time also held so that it cannot rotate and is maintained in this state with the torsional force that is applied to the torsional spring 10 not being relaxed.

[0026] In this example, the gear 23a of the horizontal gear component 23 and the gear 26a of the vertical gear component 26 that are arranged perpendicular to each other were formed on orthogonal faces. However, the engaging faces can also be conical faces as in bevel gears. Further, in the

relationship in which the balancing force generation apparatus 8 is held suspended in the balancing force adjustment apparatus 6, the connecting shaft 26d of the vertical gear component 26 is connected to the torsional spring housing tube 9 and the torsional spring 10, and the torsional spring housing tube 9 also rotates together with the torsional spring 10 due to the rotation of the vertical gear component 26. For example, the torsional spring housing tube may be supported separately and the aforementioned connecting shaft 26d and the torsional spring 10 may be connected so that only the torsional spring 10 is rotated by the rotation of the vertical gear component 26.

[0027]

[Effect of the invention] By means of this invention as described in detail above, painful operating postures are not intensified, the adjustment of balancing force can be performed easily, and, following adjustment, tight winding and unwinding adjustments can be performed simply without producing slackness and slipping. Further, stepwise adjustment is possible for both tight winding and unwinding.

[Brief Explanation of the Figures]

[Figure 1] This is a frontal view of the double-hung window 1 equipped with the balancing apparatus 5.

[Figure 2] This is a structural diagram of the balancing apparatus 5.

[Figure 3] This is a view along line III-III in Figure 1.

[Figure 4] This is a view along line IV-IV in Figure 1.

[Figure 5] This is an enlarged cross-sectional view of the balancing force adjustment apparatus 6.

[Figure 6] This is an exploded view of the balancing force adjustment apparatus 6.

[Figure 7] This shows the horizontal gear component 23. (A) is a side view, (B) is a frontal view and (C) is a bottom view.

[Figure 8] This shows the balancing force adjustment component 25. (A) is a side view, (B) is a frontal view and (C) is a bottom view.

[Figure 9] This shows the vertical gear component 26. (A) is a side view, (B) is a plane view and (C) is a bottom view.

[Explanation of the Symbols]

1 – double-hung window; 2A and 2B – vertical frame pieces; 3 – inner pane; 4 – outer pane; 5 – balancing apparatus; 6 – balancing force adjustment apparatus; 7 – stop; 8 – balancing force generation apparatus; 9 – torsional spring housing tube; 10 – torsional spring; 11 – slide block; 12 – spiral lever; 13 – rotating working element; 14 – connecting bolt; 20 – case; 23 – horizontal gear component; 23a – gear; 24 – spring component; 25 – balancing force adjustment component; 26 – vertical gear component; 26a – gear